



April 26, 2002

Mr. Chuck Whitaker
Endecon Engineering
347 Norris Court
San Ramon, California 94583

Mr. Whitaker,

Enclosed is an update from the memo on 23 April 2002 of the Plug Power PP-10 Inverter information you requested.

The information in Inverter Specification defines the grid connect specifications in accordance with IEEE P929, UL1741 and the New York State Standardized Interconnection Requirements.

The Inverter Set Point File contains the actual settings that are stored in EEPROM in the inverter.

The section on Accuracy Tracking defines the tolerance of the inverter instrumentation and equipment used for calibration.

Inverter Specification PCS_RU1_Rev1.03 PP038.doc

Plug Power Part Number 064010

6.1.1. Islanding Protection

- 6.1.1.1. *The PCS shall be non-islanding as defined by IEEE P929, UL1741 and the New York State Standardized Interconnection Requirements.*
- 6.1.1.2. *This unit is categorized as a static inverter rated below 15kW.*
- 6.1.1.3. *The built-in control software shall incorporate algorithms to detect the presence of an island condition and stop exporting power to the grid under the following circumstances:*

- *A 120Vrms 60Hz waveforms is dropped to 59V for 6 cycles*
 - *A 120Vrms 60Hz waveform is dropped to 105.6V for 120 cycles*
 - *A 120Vrms 60Hz waveform is raised to 133V for 120 cycles*
 - *A 120Vrms 60Hz waveform is raised to 166V for 2 cycles*
 - *A 120Vrms 60Hz waveform is dropped in frequency to 59.2Hz for 6 cycles*
 - *A 120Vrms 60Hz waveform is raised in frequency to 60.4Hz for 6 cycles*
- Number of cycles is measured at beginning and ending of zero crossings.*

Inverter Set Point File:

!PP-10 EEPROM setpoint file

!Version3.21-1714a	5/24/01 Category	Description
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!Address SP Val Name

0x03	60	MAX_MISSED_ZC	Max missed Zcs to stop export
0x28	1080	GC_VMIN	CM Vout Min (V)
0x29	1310	GC_VMAX	CM Vout Max (V)
0x2A	125	GC_VQMIN	CM QUICK VMIN TRIP
0x2C	210	GC_VQMAX	CM QUICK VMAX TRIP
0x2C	5940	GC_FMIN	CM Freq min (Hz x 10)
0x2D	6030	GC_FMAX	CM Freq max (Hz x 10)
0x2F	300	GC_LONG_W TIME	CM wait time till restart (grid fail)

Accuracy Tacking:

IEEE P929 / UL 1741 Spec Item	IEEE P929 UL1741 Spec Limits	Inverter Setpoints	Inverter Max Error	Accuracy Basis
Lower Islanding Voltage Limit	103 Vac	108 Vac	0.4%+40counts	Calibrated with .4 % DVM
Upper Islanding Voltage Limit	133 Vac	131 Vac	0.4%+40counts	Calibrated with .4 % DVM
Max V out-of-window cycles	120 cycles	30 cycles	.+ / - .005%	Crystal Timebase .005% Acc.
Fast Lower Islanding Voltage Limit	<60V	125Vpk=88V	0.4%+40counts	Calibrated with .4 % DVM
Fast Lower Islanding Trip Cycles	6 cycles	23mS	(see UL test p.18)	Crystal Timebase .005% Acc.
Fast Upper Islanding Voltage Limit	≥165V	210Vpk=148V	0.4%+40counts	Calibrated with .4 % DVM
Fast Upper Islanding Trip Cycles	2 cycles	4.4mS	(see UL test p.18)	Crystal Timebase .005% Acc.
Lower Islanding Frequency Limit	59.2 Hz	59.4 Hz	.+ / - .005%	Crystal Timebase .005% Acc.
Upper Islanding Frequency Limit	60.4 Hz	60.3 Hz	.+ / - .005%	Crystal Timebase .005% Acc.
Max F out-of-window cycles	6 cycles	5 cycles	.+ / - .005%	Crystal Timebase .005% Acc.

Please let me know if you have any additional questions.

Sincerely,

John Vogel
Market Engagement Manager